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Abstract: This paper proposes a new method of measuring obesity using Body Mass Index (BMI) data. Conventional measures which simply count the number of individuals with BMI in excess of an upper limit ignore the extent by which individuals exceed BMI limits and also the increased risk ratios for various conditions associated very high levels of BMI. This paper suggests that measures currently used in the poverty literature can be usefully applied to measure obesity and provide us with measures which may be more relevant from a policy perspective. The approach is applied to data for Ireland.

Keywords: Obesity, Body Mass Index.

JEL Codes: I12, I31, I32.

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Body Mass Index and the Measurement of Obesity

1. Introduction

It is no exaggeration to suggest that obesity is regarded as one of the most important health issues worldwide. For example a recent edition of the *New England Journal of Medicine* is devoted to the topic with one article suggesting that:

> "Unless effective population-level interventions to reduce obesity are developed, the steady rise in life expectancy observed in the modern era may soon come to an end and the youth of today may, on average, live less healthy and possibly even shorter lives than their parents" (Olshansky et al., NEJM, 2005).

Meanwhile a recent editorial in *The Lancet* stated:

> "Excess bodyweight is one of the most blatantly visible, yet most neglected, risk factors contributing to the overall burden of disease worldwide. At least 1.1 billion adults and 10% of children are now overweight or obese, leading to decreased life expectancy due to cardiovascular disease, type 2 diabetes and some types of cancer" (The Lancet, 2006).

Given this extent of concern regarding obesity, it is important that we measure it accurately. The most common measure of obesity used is derived from body mass index (BMI). BMI is obtained by dividing weight (in kilos) by height (in metres) squared. The World Health Organisation defines overweight and obesity with respect to BMI as follows:

Range of BMI	Weight Definition
<20	Underweight
20-24.9	Normal Weight
25-29.9	Overweight
30-39.9	Obese
≥40	Severely Obese

Thus obesity is defined as a value of BMI greater than or equal to 30. This definition of obesity is used to *identify* those who are obese. However it is also useful to be able to *aggregate* this information into a single, meaningful index of obesity.[1]The contribution of this paper is to suggest a family of such meaningful indices. We argue that this approach leads to a measure of obesity which is more useful and relevant from a policy perspective. The remainder of the paper is organised as follows. In section 2 we critically review the most commonly used ways of aggregating information regarding BMI. In this section we also introduce our proposed aggregate measures. In section 3 we apply these measures to Irish data on BMI, while section 4 presents brief concluding comments.

[1] This draws from the distinction between identification and aggregation in the measurement of poverty, first suggested by Sen (1976).

2. The Aggregation of BMI Data into Measures of Obesity

As pointed out above, the WHO definition of obesity can be used to identify obese or overweight individuals.[2] We may then wish to aggregate this information regarding BMI into a measure of obesity. The first point we must bear in mind is that when measuring obesity, we are only concerned with those individuals whose BMI exceeds 30. Thus changes in the BMI of individuals with BMI less than 30 are of no concern. This is the property of *focus* whereby attention is focussed solely on those with BMI in excess of 30.[3] The principle of focus is central to the measurement of poverty and the discussion which follows clearly draws upon the poverty measurement literature.[4]

The property of focus thus implies that examining aggregate population measures such as average BMI is not very revealing regarding obesity, since it is possible that average BMI for the population as a whole could rise, with no change in obesity e.g. if all people with BMI of say 22 suddenly reported an increase in BMI to 28. Focus implies that whatever aggregate we use must concern itself only with that part of the BMI distribution to the right of 30.

What aggregate measures then could we employ? One possibility is to simply count the number of individuals with BMI in excess of 30 and express it as a proportion of the total population (following on from the poverty measurement literature we could label this the *obesity headcount ratio*). The disadvantage of this measure, however, is that it takes no account of the extent to which people's BMI is in excess of 30. A situation where all obese people had a BMI of 30.1 and one where they all had a BMI of 40 would lead to the same measure of obesity. Yet the health implications in terms of increased risk factors for the conditions listed above might be quite different.

A further drawback of this measure is that it can give rise to perverse policy incentives. A policy-maker whose primary concern was to reduce the proportion of the population with BMI above 30 would be best off targeting those people whose BMI was just above 30. However, of the obese population, these are probably the people least in need of reducing their BMI.

A final objection to the use of the obesity headcount ratio is that it fails to obey the *principle of transfers*. The application of this principle to a measure of obesity states that a transfer of one unit of BMI from a less obese person to a more obese person will not lead to an increase in measured obesity. Indeed, if the less obese person has a BMI of 30, then such a transfer may lead to a fall in measured obesity. While it may appear somewhat strange to speak in terms of transfers of units of BMI (or indeed any

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[2] There is criticism of BMI as a measure of obesity with some authors suggesting that other measures such as total body fat, percent body fat and waist circumference are superior measures of fatness (see Cawley and Burkhauser, 2006). Since the contribution of this paper is primarily methodological, while acknowledging the importance of this issue, we still feel it is useful to apply our approach to BMI as the likelihood is that it will remain the most commonly used indicator of obesity for the foreseeable future. Also, the approach we suggest here could in principle be applied to measures such as total body fat etc.

[3] Of course it is possible that policymakers may also be concerned with individuals who are overweight i.e. a BMI over 25. In that case our focus would be on those with BMI over 25, but the basic principle that we only focus on a subset of the population remains.

[4] For a very similar approach to this with applications to US data see Jolliffe (2004).

measure of health) the concept of the principle of transfers is often invoked in the health inequality literature (see for example, Bleichrodt and Van Doorlsaer, 2006).

The first alternative to the obesity headcount ratio explicitly takes account of the degree to which individual's BMI exceeds 30. Thus following on from the poverty literature we can think in terms of an obesity gap measure. Thus suppose the critical level of BMI above which people are obese is given by BMI^*, then the gap for individual i will be given by $BMI_i - BMI^*$. The obesity gap measure, which, for reasons which will become obvious later, we label *BMI1* is then given by the sum of these gaps expressed as a percentage of total BMI in the community. Thus

$$BMI1 = \frac{\sum_{BMI_i > BMI^*} (BMI_i - BMI^*)}{n.\mu_{BMI}}$$

where μ_{BMI} is average BMI for the community.

This measure overcomes the first problem discussed with regard to the obesity headcount ratio i.e. that it does not take into account the degree to which an individual's BMI exceeds the critical limit.

The *BMI1* measure also overcomes the issue with regard to the potentially perverse incentives faced by a policy-maker – there is no extra efficacy in targeting policies at the "least-deserving" of the obese. In fact, since lowering the BMI of those whose BMI is just above the threshold to just below the threshold will lead to an increase in the average BMI of those remaining above the threshold, there is a clear incentive not to target this group.

If we divide this measure by the obesity headcount measure, then we will obtain the percentage by which the average obese person's BMI exceeds the obesity threshold. While this measure is useful in itself, it suffers from the defect that it does not obey the principal of monotonicity i.e. it is possible to have a rise in obesity and yet this figure may fall. Thus suppose an individual has a BMI just below the threshold and their BMI then rises to just above the threshold, all else being equal. Clearly this should be regarded as an increase in obesity, yet this will bring about a decrease in the proportion by which the average obese person exceeds the threshold. The reason is that an addition of an obese person with a BMI only just above the threshold will tend to *lower* the average BMI level of the obese population.

The *BMI1* measure does not (strictly) obey the principle of transfers. A transfer of a unit of obesity from one (obese) person to another will lead to no change in the value of the overall index. We now turn to a measure which will obey this principle.

As mentioned above, a property which is often considered desirable when devising an index which is intended to summarise information across the distribution is that the index be sensitive to not just changes in the average level of BMI within the obese population, but also to the distribution of BMI. This property is particularly desirable if the mortality/morbidity risks associated with higher BMI increase more than proportionately as BMI increases. Thus the mortality risk for a population increases by more if an individual's BMI increases from 39 to 40 than if it increases from 30 to 31.

There is some evidence that such non-linearity is present, for some conditions at least. For example Brown et al (2000) present data on the link between BMI and hypertension and dyslipidemia for a sample of adults in the United States. For males in their sample an increase in BMI from the range 25-27 to 27-30 leads to a statistically significant increased risk ratio for high blood pressure from 2.4 to 3.1 (compared to a risk ratio of 1.0 for BMI<25). However, an increase in BMI from 27-30 to over 30 leads to a statistically significant increase in risk ratio from 3.1 to 8.7. The comparable figures for women are for increased risk ratios from 1.7 to 2.3 to 9.1 (both statistically significant). While this data is not unambiguous evidence in favour of a non-linear effect, since the authors do not present evidence on the average BMI for those people with BMI over 30, it is strongly suggestive. Haj Jee et al (2006) present graphs of hazard ratios for death from a number of different causes against BMI for a sample of Korean adults. The graphs of the hazard ratios show a clear non-linearity with a steeper slope at higher levels of BMI.

Since public policy concern with higher BMI clearly reflects concern over increased mortality and morbidity rates, we would like an index which places a higher weight on increases in BMI at the tail of the distribution. Quite precisely how to do this is an issue which has been the subject of debate in the poverty literature. One approach would be to follow that of Sen (1976) whereby obese individuals' BMIGAP would be weighted by their ranking in the distribution of BMI for obese people. Thus the higher your rank (i.e. the more obese you are) the greater is the weighting placed upon your BMIGAP. While this goes some way towards addressing the issue it is still unsatisfactory in some respects. The relative weight assigned to an obese individual's BMIGAP will only be related to their BMI in a purely ordinal manner. Thus if the most obese person has a BMI of 50 and the next most obese person has a BMI of 40, despite this huge gap, the relative weights would differ only marginally.

A more attractive approach is that of Foster, Greer and Thorbecke (1984) whereby the weight assigned to each gap is a power of the gap itself. In general terms the index can be written as

$$BMI_\alpha = \frac{1}{n} \sum_{BMI_i > BMI*} \left(\frac{BMI_i - BMI*}{BMI*} \right)^\alpha$$

Thus the proportionate gap is weighted by the gap itself raised to the power of *α-1*. A common choice of *α* would be 2, whereby the index is a sum of squared *BMI1* indices divided by the total population size (obese and non-obese). Higher values of *α* would reflect a greater degree of "obesity-aversion". An attractive feature of this measure is that it nests the other measures proposed. Thus *α*=0 gives us the obesity headcount ratio (which we can now label *BMI0*) while *α*=1 gives the *BMI1* measure introduced above. Ultimately the value of *α* chosen is at the discretion of the analyst and it probably preferable that a range of values is used and the sensitivity of results to the value adopted is examined.

A final advantage of the BMIα measure is that it is additively decomposable. Thus the overall value of the index is a weighted sum of the values of the index for a set of mutually exclusive and exhaustive subsets where the weights are the corresponding proportions of the population. Thus it is possible to measure the contribution of a particular subgroup to overall obesity.

Before calculating these measures for Irish data, we wish to discuss one other aspect of the measures we have proposed here. Our focus so far has been on obesity. However having too *low* a BMI can also serve as a risk factor for a variety of conditions. For example, the evidence presented for US and Korean adults in Olshansky et al. (2006) and Ja Hee et al. (2006) respectively show "J" shaped hazard functions which typically reach a minimum around a BMI of about 25. The measures proposed here can be used to analyse this issue as well. Simply define a *lower* BMI threshold and apply the measures above.

It is also possible to aggregate measures relating to obesity and those relating to excessively low values of BMI by applying the above measures to all values of BMI falling outside a range of BMI_L-BMI^U, where BMI_L and BMI^U are the upper and lower thresholds respectively. The measures could then be applied to the absolute values of these gaps (otherwise gaps at either end of the distribution would cancel each other out). However, it is arguable that this would represent an excessive degree of aggregation, and it might be more fruitful to calculate the indices separately. There would also be the option of applying different values of α for excessively high and excessively low values of BMI.

Finally, mention must be made of the work of Contonyannis and Wildman (2006), which provided the original inspiration for this paper. They adopt a non-parametric approach using relative distributions to examine changes in the whole distribution of BMI. They argue that since it is individuals with low and high BMI who have higher risk ratios for various conditions, the relevant concept which policy-makers should be concerned with is relative polarisation of the distribution i.e. a situation whereby more weight is applied to the tails of the distribution, as opposed to approaches which employ summary inequality indices such as the Gini coefficient. The approach adopted here is simpler in that we concentrate only on the right hand side of the distribution and we adopt a parametric approach to put different weight upon different parts of the distribution.[5]

3. Application of the Measures to Irish Data

In this section we apply the measures outlined above to Irish data. The data comes from four waves of the Living in Ireland Survey (LII), 1998, 1999, 2000 and 2001.[6] The LII survey is a nationally representative survey which forms the Irish part of the European Community Household Panel Survey. It has been used extensively in a variety of studies on (amongst other issues) poverty, deprivation and education. Most

[5] There is also a literature on a non-parametric approach to comparing poverty distributions. See for example Atkinson (1987) and Madden and Smith (2000).

[6] For an overview of the Living in Ireland Survey, see Watson (2004).

importantly, for our purposes it has data on BMI as well as on some other socio-economic covariates of interest.[7]

One issue which inevitably arises with the use of panel data is attrition. Attrition is the process whereby households who were interviewed in the first year of the study are unavailable (for a variety of reasons) for interview in subsequent waves. Since attrition can occur on a year-by-year basis it is possible that a substantial proportion of the original sample may have been lost after a period of say, five or six years. There are two principal problems associated with attrition. The first is that if attrition happens on a non-random basis then the sample may gradually become unrepresentative. Secondly, as the sample shrinks in size it may lose precision.

There is a detailed discussion of attrition in the LII survey in Nolan et al (2002). They conclude that there is some evidence that as well as giving rise to a loss of precision, attrition in the LII survey may have been non-random. In particular, there may have been relatively higher attrition amongst households which changed address and which consisted primarily of young single adults. In response to this a booster sample, with just over 1500 new households, was introduced in 2000 with a view to alleviating the problems arising from attrition (see Watson, 2004).

For the purposes of this study, it appears there are three approaches which could be taken in the light of the presence of attrition.

(a) Simply base the analysis for each year on the basis of those observations for which we have data on BMI. Thus the sample size will rise in 2000 and 2001 following the addition of the booster sample. The advantage of this approach is that it makes the full use of what observations are available each year and ensures the highest level of precision. The disadvantage is that should the booster sample in 2000 and 2001 differ from the sample in 1998 and 1999, then results across years may not be directly comparable. Thus it may be more informative to examine how obesity changes between 1998 and 1999 and then look at the change between 2000 and 2001.

(b) Use only the "balanced panel" i.e. only those observations which appear in every year from 1998 to 2000. Obviously this implies not using the booster sample of 2000 and 2001. The advantage here is that results are directly comparable across years (it is exactly the same sample). The disadvantage is that because of attrition the sample size may be both small and possibly unrepresentative of the population as a whole. Small sample size can be particularly troublesome when we examine the decomposition of obesity by sub-group.

(c) The third approach is to both ignore attrition and also ignore the booster sample of 2000 on the basis that they are likely to differ in unobservable but perhaps important ways from the sample of 1998 and 1999. Thus we have an unbalanced panel, but we do not use the booster sample.

[7] The first wave of the LII survey dates from 1994. However, 1998 is the first year that data on body mass index was collected.

In this paper we present results for approach (a) but results for the other approaches are available on request.

We first of all present evidence on obesity for the population as a whole for the years 1998 to 2001 using BMIα for α=0,1, and 2.[8]

Table 1 shows the values of the various indices for the BMI threshold of 30. It is probably best to concentrate on the year-by-year percentage changes in the indices as in the case of the *BMI2* measure the actual values of the indices themselves have little intuitive content. Broadly speaking, the measures show similar increases in overall obesity. It is noticeable however, that the increases become greater as the value of α increases i.e. as we place a greater emphasis on the degree to which people are obese, and then again put a higher weight on the very obese, we notice greater year-on-year increases.

Bearing in mind that year-on-year comparisons are difficult given the addition of the booster sample in 2000, the figures show that all measures show rises of 3-5% in the later comparison period (2001 compared to 2000). For the earlier comparison period (1999 compared to 1998) the rise in *BMI2* is four times greater than the rise in *BMI0* or *BMI1*.

As mentioned above, one of the principal attractions of the BMIα measure is that it is additively decomposable when we have n mutually exclusive and exhaustive categories. We now present results for the obesity measures on the basis of two such breakdowns, income and education. What we might term the "obesity gradient" has been well documented for both income and education (e.g. see Sanz de Galdeano, 2005). While we would clearly expect income and education to be quite highly correlated it is possible that the gradients with respect to obesity may not show such a strong correlation. We break down the population into four educational categories: no formal qualifications, Intermediate Certificate (i.e. left school around 16 years of age), Leaving Certificate (left school around 18 years of age) and Third Level qualifications. Table 2 shows the breakdown of the sample into these four categories by year and shows a clear increase in average level of qualification. With regard to income, we break down the population into income quartiles. As our measure of income we use equivalised, after-tax, disposable income.

Tables 3a to 3d replicate table 1 for each category of education, while tables 3a to 3d does so for the four income quartiles. Tables 5a to 5d and 6a to 6d then show what we label "excess obesity" for each subcategory i.e. the obesity rate in this category and period as a fraction of the overall obesity rate for this period. The education gradient is quite clear. Obesity rates for those with the lowest education levels are up to four times higher than for those with the highest level.

Naturally, this also translates into a gradient for "excess obesity". Those with the lowest level of education have an incidence of obesity which is about 50% higher than the average population. Perhaps more worryingly, the excess increases as the value of α increases (broadly) and can approach 100% when we consider the *BMI2* measure.

[8] Standard errors for the measures are calculated using the *SEPOV* routine in STATA (these are available on request). In all cases and for all tables the year-on-year changes were statistically significant at the 1% level.

Thus the disadvantage which those with less education experience with respect to obesity is even greater when we consider high-risk obesity.

The education gradient remains pretty constant over time, despite the fact that absolute values of the indices are rising for all groups (with the possible exception of Inter Cert). It is worth pointing out that figure for *BMI2* for those with third level education shows quite a degree of year-to-year volatility.

The gradient of obesity with respect to income quartile is not as steep as in the case of education. Indeed, *BMI0* is not always monotonic with respect to income quartile. While quartile one (the lowest 25%) has the highest *BMI0* in 2001, the lowest incidence is recorded for quartile two. This lack of monotonicity can also be observed for some years for *BMI2*. There is also less dispersion in obesity rates across income quartiles than is the case for education. Tables 6a to 6d show that excess rates of obesity rarely exceed 20%. Once again, there is some evidence of the gradient becoming less steep over time, with quartile four showing some signs of catching up with the other quartiles and quartile two showing generally declining rates of excess obesity.

The greater gradient of obesity with respect to education compared to income has important policy implications. In noting the gradient with respect to income some authors have suggested that obesity is largely an economic issue and that the growth in obesity (in the US at least) may be due to disparities in incomes and wealth and the declining value of the minimum wage (see for example, Drewnowski and Darmon, 2005). The evidence presented here does not deny the relevance of income, but it suggests that education may play an even more important role.

4. Conclusion

This paper has argued that much of the conventional approach to presenting information on obesity is deficient. While the threshold BMI level of 30 is used to identify those people who are obese, relatively little attention has been paid as to how this information might be aggregated into single statistics which can convey useful and meaningful information regarding obesity. We argue that the measurement of obesity can learn much from the measurement of poverty and we have adapted some of the common poverty measures to summarise obesity data. We believe that this approach provides a very useful supplement to the summary measures of obesity which are commonly presented and as an illustration of this we apply these measures to Irish data.

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Table 1: Obesity Measures 1998-2001, Threshold BMI=30

Measure	1998	1999	2000	2001	Cum. %
BMI0	0.0836	0.0861*	0.097*	0.1025*	
% change		*2.974*	*13.249*	*5.054*	***22.511***
BMI1	0.0081	0.0083*	0.0097*	0.010*	
% change		*2.47*	*16.87*	*3.09*	***23.46***
BMI2	0.0016	0.0018*	0.0020*	0.0021*	
% change		*12.602*	*8.131*	*5.885*	***28.922***

* indicates statistically significant difference (1%) – comparison is with same obesity measure for previous year.

Table 2: Highest Level of Education (%), 1998-2001

Level	1998	1999	2000	2001
No Quals	29.05	26.52	26.51	23.48
Inter Cert	26.06	25.40	24.28	23.29
Leaving Cert	29.47	30.63	30.86	32.65
3^{rd} Level	15.41	17.45	18.40	20.59

Table 3a: Obesity Measures 1998-2001, No Qualifications

Measure	1998	1999	2000	2001	Cum. %
BMI0	0.1234	0.1254*	0.1371*	0.1546*	
% change		*1.65*	*9.26*	*12.78*	***25.25***
BMI1	.01317	.01369*	.01424*	.01778*	
% change		*3.90*	*4.06*	*24.86*	***34.99***
BMI2	0.003	0.0032*	0.0028*	0.0042*	
% change		*5.46*	*-12.25*	*49.01*	***37.9***

Table 3b: Obesity Measures 1998-2001, Inter Cert

Measure	1998	1999	2000	2001	Cum. %
BMI0	0.0866	0.0887*	0.0971*	0.1001*	
% change		*2.43*	*9.45*	*3.09*	***15.57***
BMI1	.00832	.00781*	.00950*	.00910*	
% change		*-6.17*	*21.74*	*-3.97*	***9.43***
BMI2	0.0016	0.0015*	0.0017*	0.0015*	
% change		*-4.78*	*12.48*	*-9.9*	***-3.5***

Table 3c: Obesity Measures 1998-2001, Leaving Cert

Measure	1998	1999	2000	2001	Cum. %
BMI0	0.0652	0.0613*	0.0778*	0.0834*	
% change		*-6.05*	*27.03*	*7.13*	***27.86***
BMI1	.00551	.00524*	.00719*	.00853*	
% change		*-4.88*	*37.20*	*18.59*	***54.77***
BMI2	0.0009	0.0009*	0.0015*	0.0017*	
% change		*1.27*	*56.52*	*14.24*	***81.09***

Table 3d: Obesity Measures 1998-2001, Third-Level

Measure	1998	1999	2000	2001	Cum. %
BMI0	0.0478	0.0688*	0.0740*	0.0760*	
% change		*44.06*	*7.6*	*2.65*	***59.13***
BMI1	.00405	.00629*	.00774*	.00595*	
% change		*55.48*	*22.98*	*-23.08*	***47.08***
BMI2	0.0006	0.0018*	0.0020*	0.0010*	
% change		*192.58*	*13.75*	*-50.91*	***63.37***

* indicates statistically significant difference (1%) – comparison is with same obesity measure for previous year.

Table 4a: Obesity Measures 1998-2001, Quartile 1

Measure	1998	1999	2000	2001	Cum. %
BMI0	0.0867	0.0930*	0.1030*	0.1182*	
% change		*6.92*	*11.12*	*14.71*	***36.28***
BMI1	.00931	.0089*	.01123*	.01184*	
% change		*-4.89*	*26.90*	*5.4*	***27.22***
BMI2	0.0020	0.0015*	0.0024*	0.002*	
% change		*-23.64*	*59.04*	*2.98*	***25.07***

Table 4b: Obesity Measures 1998-2001, Quartile 2

Measure	1998	1999	2000	2001	Cum. %
BMI0	0.0926	0.0824*	0.0958*	0.0940*	
% change		*-10.97*	*16.25*	*-1.73*	***1.71***
BMI1	.00938	.00854*	.01022*	.01062*	
% change		*-8.95*	*19.71*	*3.94*	***13.30***
BMI2	0.0021	0.0025*	0.0020*	0.0025*	
% change		*20.67*	*-21.07*	*25.31*	***19.35***

Table 4c: Obesity Measures 1998-2001, Quartile 3

Measure	1998	1999	2000	2001	Cum. %
BMI0	0.0887	0.0898*	0.0989*	0.0956*	
% change		*1.37*	*10.14*	*-3.41*	***7.84***
BMI1	.00789	.00925*	.009028*	.0100*	
% change		*17.08*	*-2.39*	*10.89*	***26.73***
BMI2	0.0015	0.0022*	0.0016*	0.0019*	
% change		*54.75*	*-28.36*	*17.93*	***30.74***

Table 4d: Obesity Measures 1998-2001, Quartile 4

Measure	1998	1999	2000	2001	Cum. %
BMI0	0.0653	0.0786*	0.0904*	0.1012*	
% change		*20.37*	*14.9*	*11.99*	***54.89***
BMI1	0.0057	.00641*	.0082*	.00874*	
% change		*12.86*	*28.25*	*6.09*	***53.56***
BMI2	0.0001	0.0010*	0.0019*	0.0015*	
% change		*6.61*	*84.64*	*-21.83*	***53.86***

* indicates statistically significant difference (1%) – comparison is with same obesity measure for previous year.

Table 5a: Excess Obesity, 1998-2001, No Qualifications

	1998	1999	2000	2001
BMI0	1.4756	1.4567	1.4125	1.5086
BMI1	1.6300	1.6550	1.4725	1.7254
BMI2	1.8726	1.7539	1.4233	2.0030

Table 5b: Excess Obesity, 1998-2001, Inter Cert

	1998	1999	2000	2001
BMI0	1.0353	1.0298	1.0004	0.9767
BMI1	1.0294	0.9438	0.9825	0.8833
BMI2	0.9820	0.8304	0.8638	0.7350

Table 5c: Excess Obesity, 1998-2001, Leaving Cert

	1998	1999	2000	2001
BMI0	0.7797	0.7114	0.8020	0.8137
BMI1	0.6822	0.6340	0.7438	0.8279
BMI2	0.5688	0.5116	0.7406	0.7990

Table 5d: Excess Obesity, 1998-2001, Third Level

	1998	1999	2000	2001
BMI0	0.5710	0.7988	0.7629	0.7417
BMI1	0.5008	0.7607	0.8000	0.5776
BMI2	0.3743	0.9725	1.0230	0.4742

Table 6a: Excess Obesity, 1998-2001, Quartile 1

	1998	1999	2000	2001
BMI0	1.0371	1.0768	1.0620	1.1537
BMI1	1.1518	1.0703	1.1614	1.1491
BMI2	1.2293	0.8336	1.2261	1.1925

Table 6b: Excess Obesity, 1998-2001, Quartile 2

	1998	1999	2000	2001
BMI0	1.1067	0.9569	0.9872	0.9188
BMI1	1.1602	1.0322	1.057	1.0308
BMI2	1.2753	1.3667	0.9977	1.1807

Table 6c: Excess Obesity, 1998-2001, Quartile 3

	1998	1999	2000	2001
BMI0	1.0596	1.0431	1.0196	0.9327
BMI1	0.9776	1.1183	0.9335	0.9714
BMI2	0.9000	1.2370	0.8195	0.9128

Table 6d: Excess Obesity, 1998-2001, Quartile 4

	1998	1999	2000	2001
BMI0	0.7812	0.9131	0.9312	0.9876
BMI1	0.7031	0.7753	0.8503	0.8484
BMI2	0.5918	0.5603	0.9568	0.7063